CORRESPONDENCE/MEMORANDUM

State of Wisconsin

DATE: December 19, 2003 FILE REF:

TO: Caroline Garber – AM/7
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FROM: Mark K. Allen – AM/7

SUBJECT: BFI's Lake Area Landfill near Sarona - Monitoring Results

Background

The Lake Area Landfill, operated by Browning-Ferris Industries, Inc., hereafter BFI, is located south of Highway D and west of Sarona, WI. The landfill is located on a 320-acre site containing two closed landfills and one active landfill. The landfill is situated in remote to rural surroundings. The terrain of the landfill and the nearby surrounding area are characterized by flat or low rolling hills.

The landfill began operations at the site in the 1970s. The facility accepts primarily municipal solid waste. One area of the active landfill is an ash monofill accepting municipal waste ash from the Barron County incinerator and the Hennipen County Incinerator. Total acreage for all three of the landfills is 65.8 (NR151 - 11 acres, South Expansion - 14 acres, and East Expansion/active landfill - 40.8). The landfill operators (BFI) are currently requesting permits to open an additional 70.3 acres for a horizontal expansion with 13.5 acres for a vertical expansion over a portion of the East Expansion.

The landfill has a gas extraction system to collected and burn accumulating landfill gas. The two closed sites, with final covers, are hooked to the gas system along with a portion of the East Expansion. The site operators connect gas wells and leachate clean-out pipes from the East Expansion to active gas extraction system when waste depths on the site are sufficient to allow gas extraction. Collected gases are burned in an open flare using bottled gas to support combustion.

The planned expansion of the Lake Area Landfill has raised citizen concerns and the Air Monitoring Section was asked to conduct gas testing and air monitoring at the facility to determine if any of the emissions might pose a threat to the nearby resident's health. The monitoring objectives for the study were to conduct a comprehensive monitoring survey of landfill gases. Ambient measurements of fenceline gases would be conducted if possible. Air monitoring is not able to estimate emissions associated with the exposed garbage from the active face of the landfill.

Monitoring was conducted at the facility on November 20, 2003. This memorandum summarizes the monitoring results from all monitoring activities performed on that date.

Monitoring Results

Monitoring at the landfill was conducted using protocols similar to those used in previous landfill studies and was modeled on the draft Monitoring plan for the Portage county landfill issued

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6/1/2000. Monitoring was to be conducted at the gas extraction system, above the landfill surface, at gas wells on the closed area of the landfill, and if possible at a down-wind fence-line location.

Monitoring on November 20 included the collection of gas samples at the gas extraction system. In addition real time measurements were made at the gas extraction system using two analyzers. Finally a survey of the closed landfills (NR151 and the South Expansion) was made using the Jerome H2S meter to look for leaks of fugitive gas. Ambient weather conditions were not favorable for ambient monitoring. Modererate winds of from approximately 8 to 13 mph were coming from the south and southwest. An odor survey along Highway D to the north of the landfill and along Kekegama Lake Road to the east did not turn up any noticeable odors of landfill gas. Because of the lack of fenceline odors I decided not to collect ambient air samples. Terry Koehn was supplied with a canister grab sampler to collect an air sample should he get future complaints during a period of calm winds and noticeable odors.

The monitoring results are summarized on Tables 1,2 & 3.

Discussion of Results

The gas extraction system (GES) is the most significant point for the emission of landfill gas at the Lake Area Landfill. This monitoring project collected two sets of samples from the gas extraction system to develop an understanding of the compounds present in the landfill gas. The testing of the landfill gas detected 28 individual compounds and the summed concentration for two compounds groups (petroleum distillates and napha). All gas samples collected for these measurements were collected from the gas extraction system at a port before the flare. Separate gas samples were collected to monitor hydrogen sulfide. Using a standard Pitot tube I made a direct measurement of the gas flow during this monitoring session. The sampling port for gas collection was too small for the Pitot tube and the port closest to the blower motor shelter was used. The port used is the same port where the automated flow meter is connected. The automated flow meter was not operational during the time I visited the site. Measurements estimated the landfill gas flow to be 873 Dry Standard Cubic Feet per Minute (DSCFM) or 24.7 cubic meters per minute (M^3/minute).

Using both the gas concentrations and the gas flow data I developed theoretical emission rates for untreated landfill gas. The reader should note that the landfill gas is treated by combustion in a flare. Emission data is reported in Table 3 of this report. Of the 28 compounds only 15 are regulated under the Wisconsin DNR's NR445 rules (Air Program Regulations). All 15 regulated compounds are less than the current deminus limits[1] set forth in NR445.

Survey measurements of fugitive hydrogen sulfide emissions failed to show any leaks from the surface cap, or structural features (manholes, gas well, or leachate clean-out wells) in the closed landfill.

The real time meters used in the survey did show the landfill gas contained hydrogen sulfide and this was confirmed by the gas samples collected. The LUMEX meter detected concentrations of

[1] The deminimus limit has been determined by a modeling analysis of a generic stack less than 25 feet in height. The limit is calculated as the emission rate at which the ambient concentration is less that 2.4% of the ACGIH TLV concentration at the point of maximum impact. For stacks less than 25 feet in height the maximum impact point for a 24-hour time period is located approximately 20 meters from the stack. This maximum impact point would be within the landfill boundary.

mercury in the landfill gas. Direct measurements of the landfill gas from the blower port showed mercury in the range of 700 to 900 ng/m3. This would indicate a mercury emission rate of 1.1 to 1.4 mg/hour or an annual emission of 9 to 12 grams (2.4E-6 to 3.1E-6 pounds per hour or 0.0021 to 0.0027 pounds per year). This emission rate is less that Table 1 limit for mercury of 0.00408 pounds/hour or the Table 5 limit of 63 pounds/year listed in Wisconsin NR445 regulations.

Conclusions:

Sampling of the landfill gas from the gas extraction system has shown that the gas does carry detectable concentrations of hazardous compounds. The emission rates (calculated as maximum possible emissions) for these hazardous compounds are below the limits regulated by the Wisconsin's Air Program rule NR445. The gas extraction system at the Lake Area Landfill burns the gas in a flare, which should significantly reduce or eliminate the concentrations of the hazardous compounds.

Measurement of mercury did show concentrations higher than seen in previous landfill gas monitoring. In the Fall of 2003 the Wisconsin DNR began preliminary testing of landfill gas for mercury. Testing on three closed landfill showed detectable mercury at concentration of <15 ng/M3. Mercury measured at the Lake Area Landfill was 45 to 60 times the concentrations measured in the Fall monitoring survey. Mercury detected in the landfill gas would not be controlled by the flare. The LUMEX analyzer used for this study is only a survey instrument and is subject to both drift and environmental effects. Monitoring does show the gas extraction system is emitting mercury, but the emissions can not be determined with a high confidence. I therefore recommended that the site operators make a definitive mercury measurement on the landfill gas as part of future planned environmental testing at the site.

Table 1: Lake Area Landfill Gas Concentration Data for Samples 11/20/2003				
Table 1(a): Volatile Organic Compounds				
Sample Number	BFI03-001	BFI03-002	BFI03-006	BFI03-007
Sample Time	10:47 – 11:47	10:47 – 11:47	13:21-14:21	14:21
Location	GES – Sampling Port	GES – Sampling Port	GES – Sampling Port	Blank
Compound Name	mg/M3	mg/M3	mg/M3	mg/M3
Acetone	68	52	61	<.33
Benzene	4.3	3.2	3.6	<.07
Butyl Acetate	<=9.5	<=7.6	<=8.3	<.28
Butyl Alcohol (n)	38	29	38	<.12
Butyl Alcohol (s)	35	26	35	<.17
Chloro-4-trifluoromethylbenzene	<=3.8	<=2.9	<=3.3	<.25
Cumene	5.8	4.6	5	<.08
Dichlorobenzene	2.8	2.2	2.4	<.15
Ethyl Alcohol	91	64	110	<.83
Ethyl Benzene	42	33	36	<.08
Ethyl Butyrate	45	36	40	<.23
Hexane (n-)	6.1	4.1	5.2	<.08
Isopropyl Alcohol	35	26	37	<.15
Limonene	35	29	31	<.08
Methyl Ethyl Ketone	100	81	90	<.33
Methyl Isobutyl Ketone	22	17	19	<.12
Methyl Styrene	<=2.0	<=2.3	<=2.2	<.08
Naphtha (>=C11 hydrocarbons))	64	50	56	<.08
Petroleum Distillates (<C11)	600	490	560	<.08
Pinene (a)	67	53	61	<.17
Pinene (b)	19	15	17	<.17
Styrene	5.4	4	3.9	<1.67
Toluene	74	59	63	<.07
Trimethylbenzene (1,2,3)	2.4	1.9	2.1	<.08
Trimethylbenzene (1,2,4)	9.4	7.5	8.1	<.08
Trimethylbenzene (1,3,5)	5.2	4.1	4.5	<.08
Xylene	81	65	70	<.08
Table 1(b) Reduced volatile sulfurs				
Sample Number	BFI03-003	BFI03-004	BFI03-005	BFI03-008
Sample Time	10:47 – 11:47	13:21-14:21	13:21-14:21	14:21
Location	GES – Sampling Port	GES – Sampling Port	GES – Sampling Port	Blank
Compound Name	mg/M3	mg/M3	mg/M3	mg/M3
Hydrogen Sulfide	47	49	43	1.2
Notes: mg/M3: milligrams (0.001 grams) per cubic meter of gas Blank concentrations are calculated on a theoretical gas volume of 6 Liters. Duplicate VOC samples were collected from 10:47 to 11:47. Duplicate H2S samples were collected from 13:21 to 14:21				

Table 2: Fugitive and Source Gas Survey at the Lake Area Landfill						
TIME	LOCATION	ANALYZER	PARA-METER	VALUE	UNITS	COMMENTS
	Background	LUMEX	Hg	5	ng/M3	Rezero
12:40	Gas extraction system (LFG)	LUMEX	Hg	882	ng/M3	
12:45	Upwind	LUMEX	Hg	6 to 11	ng/M3	
12:48	downwind of flare	LUMEX	Hg	30	ng/M3	
12:50	Leachate collection area	LUMEX	Hg	46	ng/M3	
12:55	Upwind	LUMEX	Hg	1	ng/M3	Rezero
12:57	Gas extraction system (LFG)	LUMEX	Hg	911	ng/M3	
12:58	Ambient	LUMEX	Hg	17	ng/M3	After removal from system
13:31	Above GES sampling port	JEROME	H2S	0.57	ppm	
	Above close landfill sec 115	JEROME	H2S	0	ppm	Started walking tour of closed cells
	GW2 – above	JEROME	H2S	0	ppm	
	GW2 – near base	JEROME	H2S	0	ppm	
	GW11 – animal hole near base	JEROME	H2S	0	ppm	
	manhole NW corner	JEROME	H2S	0	ppm	
	walking on surface	JEROME	H2S	0	ppm	
	Southside ditch	JEROME	H2S	0	ppm	
13:45	moved to South Expansion	JEROME	H2S	0	ppm	
	leachate wells between closed cells	JEROME	H2S	0	ppm	
	manhole MR-1	JEROME	H2S	0	ppm	
	SEW3	JEROME	H2S	0	ppm	
	electrical pipes	JEROME	H2S	0	ppm	
	LHW4	JEROME	H2S	0	ppm	
	manhole SE top	JEROME	H2S	0	ppm	
	CS3r	JEROME	H2S	0	ppm	end walking tour (no odors noticed by operator)
14:08	above GES sampling port	JEROME	H2S	0.26	ppm	
15:08	at Gas Extraction System	JEROME	H2S	0	ppm	Start-up
	LFG#1	JEROME	H2S	16	ppm	Attached directly to LFG port
	LFG#2	JEROME	H2S	8.4	ppm	
	LFG#3	JEROME	H2S	6.7	ppm	
	Ambient	JEROME	H2S	0.006	ppm	
	Ambient	JEROME	H2S	0.003	ppm	
	Ambient	JEROME	H2S	0.001	ppm	
	LFG#4	JEROME	H2S	7.8	ppm	
	LFG#5	JEROME	H2S	6	ppm	
	LFG#6	JEROME	H2S	5.3	ppm	
	Ambient	JEROME	H2S	0.004	ppm	
	Ambient	JEROME	H2S	0.004	ppm	
	Ambient	JEROME	H2S	0.002	ppm	Completed gas measurement
15:16	GES Fenceline - upwind	LUMEX	Hg	12	ng/M3	Background
	LFG#1	LUMEX	Hg	736	ng/M3	
	LFG#2	LUMEX	Hg	703	ng/M3	

Table 2: Fugitive and Source Gas Survey at the Lake Area Landfill (cont.)						
TIME	LOCATION	ANALYZER	PARA-METER	VALUE	UNITS	COMMENTS
	LFG#3	LUMEX	Hg	719	ng/M3	
	Ambient	LUMEX	Hg	-52	ng/M3	
	Ambient	LUMEX	Hg	-54	ng/M3	
	Ambient	LUMEX	Hg	-56	ng/M3	
	LFG#4	LUMEX	Hg	716	ng/M3	
	LFG#5	LUMEX	Hg	707	ng/M3	
	LFG#6	LUMEX	Hg	694	ng/M3	
	Ambient	LUMEX	Hg	-71	ng/M3	
	Ambient	LUMEX	Hg	-74	ng/M3	
	Ambient	LUMEX	Hg	-75	ng/M3	
	Baseline	LUMEX	Hg	-17	ng/M3	After rezero
	Baseline	LUMEX	Hg	-22	ng/M3	
	Baseline	LUMEX	Hg	-27	ng/M3	

Notes:
ng/M3: nanograms(0.000000001 grams) per cubic meter of gas
ppm: part per million
The LUMEX analyzer is a survey instrument and is subject to baseline drift. Negative reading measured on the LUMEX are most likely caused by a drifting baseline.

Table 5: Estimated Emission from Landfill Gas Extraction System (if unflared)

Compound Name	Emissions (pounds/ hour)	Emissions (pounds/ year)	Regulated under NR445 Table	NR445 Limit	NR445 Emission units
Acetone	0.197	1729	Not regulated		
Benzene	0.012	106	3(A)	300	lb/year
Butyl Acetate	0.028	242.6	Not regulated		
Butyl Alcohol (n)	0.115	1003.1	1	7.596	lb/hour
Butyl Alcohol (s)	0.105	917.2	Not regulated		
Chloro-4-trifluoromethylbenzene	0.011	95.6	Not regulated		
Cumene	0.017	147.2	4	85.7	lb/hour
Dichlorobenzene	0.008	70.7	1	1.5624	lb/hour
Ethyl Alcohol	0.289	2531.7	Not regulated		
Ethyl Benzene	0.121	1060.4	1	36.228	lb/hour
Ethyl Butyrate	0.132	1155.9	Not regulated		
Hexane (n-)	0.017	147.2	1	14.99904	lb/hour
Hydrogen Sulfide	0.152	1327.9	4	1.1664	lb/hour
Isopropyl Alcohol	0.107	936.3	Not regulated		
Limonene	0.104	907.5	Not regulated		
Methyl Ethyl Ketone	0.296	2588.8	Not regulated		
Methyl Isobutyl Ketone	0.063	554.1	1	17.07	lb/hour
Methyl Styrene	0.007	62.2	4	19.99	lb/hour
Naphtha	0.185	1624	Not regulated		
Petroleum Distillates	1.799	15762.9	Not regulated		
Pinene (a)	0.197	1729	Not regulated		
Pinene (b)	0.056	487.3	Not regulated		
Styrene	0.015	127.1	1	17.90604	lb/hour
Toluene	0.214	1872.3	1	31.2312	lb/hour
Trimethylbenzene (1,2,3)	0.007	61.2	4	10.4112	lb/hour
Trimethylbenzene (1,2,4)	0.027	238.9	4	10.4112	lb/hour
Trimethylbenzene (1,3,5)	0.015	131.9	4	10.4112	lb/hour
Xylene	0.236	2063.5	1	36.228	lb/hour

1. Reported NR 445 limits are for a stack of <25 ft. in height.
2. All emission rates reported here were calculated for the gas concentration reported in Table 1. The "(*)" indicates the reported Table 1 concentration was the maximum possible concentration in the gas. Therefore the emission rate would also be the maximum possible emission rate.
3. lb/hour: pounds per hour, lb/year: pounds per year.


Flare
Pump Shelter
Sampling Ports

FIGURE 1 : Lake Area Landfill Gas extraction system.

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